Sinewave;

Is the Voltage Generated in relation to the angle or position of the rotor in the magnetic field.

Period;

The amount of time required for the rotor to make 1 complete revolution. In units of Seconds [Sec], [μS]

Frequency;

Is the number of complete revolutions [360º] of the Generator in 1 Second. Unit of Measure; Hertz, (Hz & KHz).

μ Sec ⇄ KHz

m Sec ⇄ Hz

Note; Only Period can be measured on the O Scope.

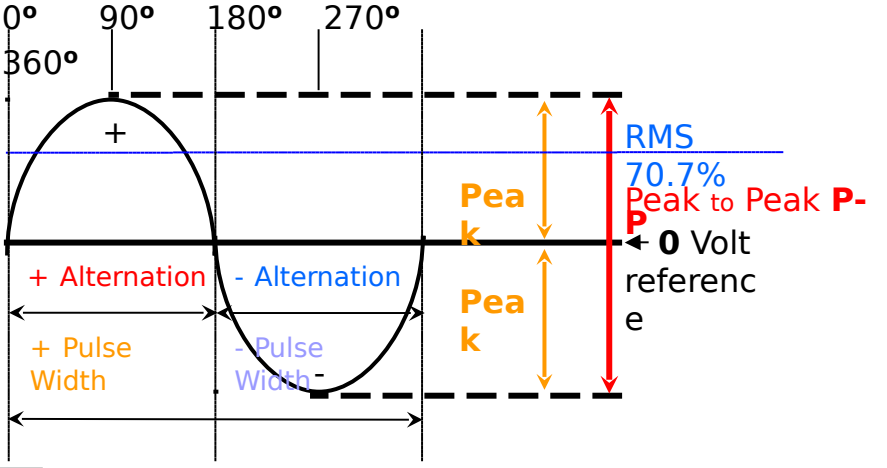
Period to Frequency;

If Period is known, Frequency can be calculated.
1/ Period or [**Period 1/X**] ⇒ Freq In [Hz]

Frequency to Period;

Frequency to Period; If Frequency is known, Period can be calculated.
1/Freq or [Freq 1/X] ⇒ Period In [SEC]

Sinewave Profile;

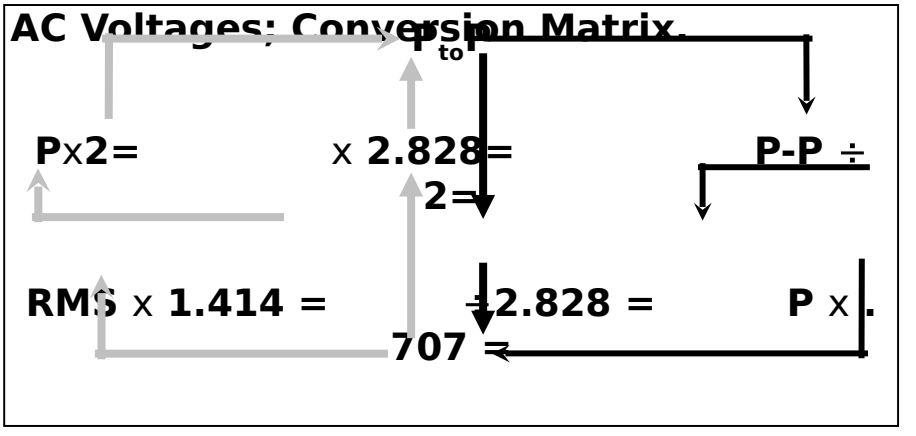


AC Voltages Conversion;

P-P ÷ 2 = Pk.
P x .707 = RMS
RMS x 1.414 = Pk.
Px2 = P-P

P-P ÷ 2.828 = RMS
RMS x 2.828 = P-P

AC Voltages; Conversion Matrix.



AC: CONDENSERS.
INDUCTORS.

Inductor;

Opposes any change in Current & stores energy in an Electromagnetic Field.

Symbol; **L**

Unit of Measure; Unit of Measure; henrys, **h** *lower case* , **mh** milli henrys

3 Types; Air Core, Iron Core, Variable.

LT
L in Series

Are Additive Like Resistors in **Series**,
(L1 + L2 + L# = LT).

LEQ
L in Parallel

Are calculated Like Resistors in **Parallel**,
(L1 1/X + L2 1/X = 1/X = LEQ).

LT
L in Series-Parallel

Are calculated Like Resistors in **Series-Parallel**, **(LEQ + Inductors in series = LT).**

XL;

Inductive Reactance;

Reactance; Because the Inductor is a Frequency sensitive device, it will change in value of opposition as the Frequency changes. Since its value cannot be measured, it has to be calculated, with frequency as part of the equation.

Reactance, Symbol; X Unit of Measure; Ω Ohms
Inductive Reactance; XL Unit of Measure; Ω Ohms

Formula; X_L

"2 Pies For Lunch"
2 π F L
2 π X Frequency X Inductor

2 π = 6.28

Freq=10KHz L= 5 mh

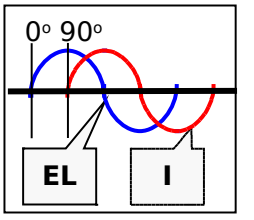
On the **Calculator;**

2 π x 10 KHz x 5 mh = XL in Ω

X_L **= 6.28 X 10 EE 3 X 5 EE-3 = 314.** Ω

Phase Relationship;

Voltage [EL] Leads Current by 90°



Memory Aid;

E L I the ice man is 90 years old

Phase Relationship; continued.

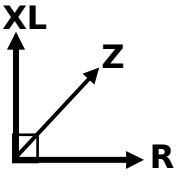
$2 \pi F L = X_{LT}$ in Ω

A DIRECT RELATIONSHIP exists between the **XL** and Frequency and the size or Value of the Inductor.

A DIRECT RELATIONSHIP exists between the **XL** & **EL**

If; **F** ⇑ or **L** ⇑ then **XL** ⇑ and the **EL** ⇑.

IMPEDANCE;



Total opposition to AC. With a circuit containing non-reactive & reactive components they are added using Vectors. Unit of measure; **Ω,** Symbol; **Z**

$$Z = \sqrt{R^2 + X_L^2} \quad \text{or} \quad Z = \sqrt{R_T^2 + X_{LT}^2}$$

On the **Calculator;**

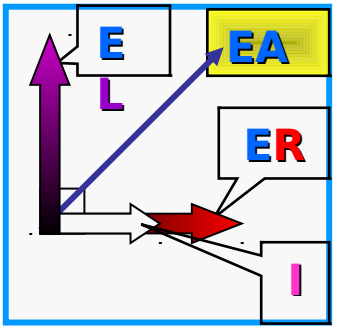
R X^2 + **XL** X^2 = $\sqrt{X}$ ⇒ **Z** in **Ω**

Example;

If; **R= 5Ω** & **XL = 376 Ω;** then $Z = \sqrt{5\Omega^2 + 376\,\Omega^2}$

5 Ω X^2 + **376 Ω** X^2 = $\sqrt{X}$ ⇒ **376.033 Ω**

Applied Voltage;



Because opposition was added vector-ally, the individual voltage drops must be added vector-ally

$$EA = \sqrt{E_{RT}^2 + E_{LT}^2}$$

E_R X^2 + E_L X^2 $\sqrt{=}$ X ⇒ EA

Sequential Order; Problem Solving

$X_{LT} = 2\pi F L_T$

$R_T = R_1 + R_2$

$Z_T = \sqrt{R_T^2 + X_{LT}^2}$

$I_T = EA \div Z$

$E_{R\#} = I_T \times R_\#$

$E_{L\#} = I_T \times X_{L\#}$

$EA = \sqrt{E_{RT}^2 + E_{LT}^2}$

AC: CONDENSERS.
CAPACITORS.

Capacitors;

Opposes any change in Voltage & stores energy in an Electrostatic Field.

Symbol; **C**

Unit of Measure; Unit of Measure; **Farads**, **f** *lower case* , **µf** micro farads

3 Types; Fixed value, electrolytic, Variable.

CEQ Parallel Caps in Parallel is Additive Like Resistors in **Series**, **(C1 + C2 + C# = CT).**

CT Series Caps in Series is calculated Like Resistors in **Parallel**, **(C1 1/X + C2 1/X = 1/X = CEQ).**

CT Series-Parallel Caps in parallel portion are additive to = CEQ. The CEQ is now in series w/ the other series Cap (s). Both are calculated like caps in parallel. **(C1 1/X + CEQ 1/X = 1/X = CT).**

XC;

CAPACITIVE REACTANCE;

Because the capacitor is a frequency sensitive device, it will change in value of opposition as the frequency changes. Since its value cannot be measured, it has to be calculated, with frequency as part of the equation.

Reactance, Symbol; X Unit of Measure; Ω Ohms
Capacitive Reactance; XC Unit of Measure; Ω Ohms

Formula; X_C

"1 over 2 Pies For chow"

$$\frac{1}{2\pi F C}$$

2 π X **Frequency** X **Capacitor 1**/X

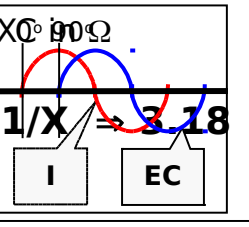
2 π = 6.28

Freq= 10KHz L= 5 µf

On the **Calculator;** **2** π x 10 KHz x 5 µf = XC in Ω

Phase Relationship;

X_C **= 6.28 X 10 EE** ^{3} **X 5 EE** $^{-6}$ **1/X => 3.18 Ω**



Memory Aid; **Voltage [EC] LAGS Current by 90°**

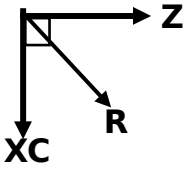
Phase Relationship; continued.

An **INDIRECT RELATIONSHIP** (or opposite) exists between the **XC** and Frequency and the size/ Value of the Capacitor.

A Direct relationship exists between the **XC** & **EC**

If: **F** ↑ or **L** ↑ then **XL** ↑ and the **EL** ↑.

IMPEDANCE;



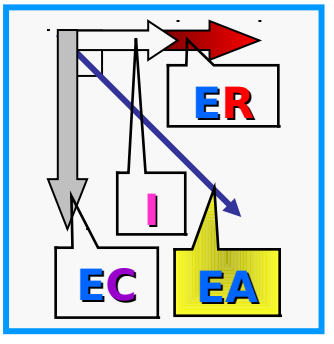
Total opposition to AC. With a circuit containing non-reactive & reactive components they are added using Vectors. Unit of measure; **Ω,** Symbol; **Z**

$$Z = \sqrt{R^2 + X_C^2} \quad \text{or} \quad Z = \sqrt{R_T^2 + X_{CT}^2}$$

On the **Calculator;**

R X^2 + XC X^2 = $\sqrt{x}$ ⇒ Z in Ω

Applied Voltage;



Because opposition was added vector-ally, the individual voltage drops must be added vector-ally

$$EA = \sqrt{E_{RT}^2 + E_{CT}^2}$$

E_R X^2 + E_C X^2 $\sqrt{=}$ X

⇒ EA

Sequential Order; Problem Solving

$$X_{CT} = \frac{1}{2\pi F C_T} \qquad E_{C\#} = I_T \times X_{C\#}$$

$$R_T = R_1 + R_2 \qquad EA = \sqrt{E_{RT}^2 + E_{CT}^2}$$

$$Z_T = \sqrt{R_T^2 + X_{CT}^2}$$

$$I_T = EA \div Z$$

$$E_{R\#} = I_T \times R_{\#}$$

AC: CONDENSERS.
RC TRANSIENT.

Transient Waveform;

A waveform that changes from one steady state to another or is positive for a period of time, then Negative for an equal period of time. A Sine wave is not a transient waveform.

Square Triangular Saw tooth Spike

RC Ckt;

A Ckt comprising of a Resistor & Capacitor in series where the rate [time] of Charge & Discharge is dictated by the value [size] of the Resistor & Cap.

1 Time Constant [TC]

1 TC is the amount of time required for a Capacitor to charge to 63% of the applied. 5 TC will charge a cap to 100%.

TC = R X C in Micro Seconds only, µS .

Pulse Width;

$$PW = \frac{1}{2\ F} \qquad PW = \frac{1}{2 \times Freq}$$

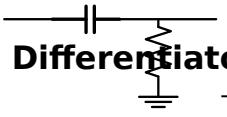
On the Calculator;

If Frequency; = 50 KHz
50 EE3 X 2 = 1/X ⇒ .00001 Sec
PW = 10. µS

TC to PW Ratio;

The **TC** tells us how much **time is NEEDED** to charge a Capacitor to 63% of the Applied Voltage.
The **PW** tell us how much **time we HAVE** to charge a Capacitor to 63% of EA. Expressed as ratio in the lowest terms. 1/10, 10/1.

Circuit Types;

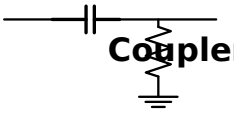


Differentiator;

Output taken across; Resistor
TC/PW ; Short
Output waveform;
Spiked

Integrator;

Output taken across; Cap
TC/PW ; Long
Output waveform;
Triangular



Coupler;

Output taken across; Resistor
TC/PW ; Long
Output waveform;
Square

LR Circuit;

LR Ckt; A Ckt comprised of a Resistor & Inductor in series, where the rate [time] of Expansion & Contraction is dictated by the value [size] of the Resistor & Inductor.

TC;

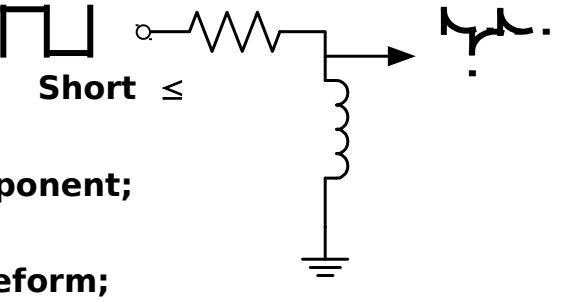
1 TC is the Time for current to reach approximately 63% of maximum expansion. 5 TC for 100%.

TC = L/R, In μ**Sec** only

Pulse Width; [PW]

PW In μ**Sec** only **= 2 X Freq 1/X**

Differentiator;

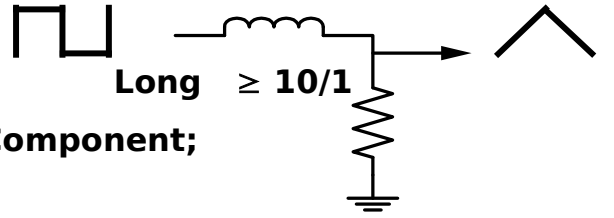


TC/PW; Short ≤ 1/10

Output Component; Inductor

Output Waveform; Spiked

Integrator;

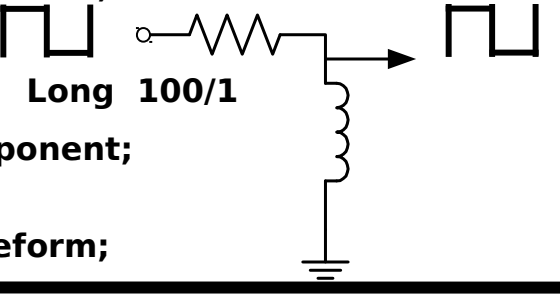


TC/PW; Long ≥ 10/1

Output Component; Resistor

Output Waveform; Triangular

Coupler;



TC/PW; Long 100/1

Output Component; Inductor

Output Waveform; Square

LCR;

Impedance;

Z

Is the total Opposition to AC, Unit Ω.
Because of the 180° Out Phase relationship of the XL & XC the difference must be calculated.
If they are Equal, they will cancel each other out, and only Resistance remains.

Formula;

$$Z = \sqrt{RT^2 + (XL - XC)^2}$$

On The Calculator;

XC - XL = X ² + RT X ² = √ X

LCR; Cont;
Applied Voltage;

Because of the 180º Out Phase relationship of the EL & EC the difference must be calculated.

If they are Equal, they will cancel each other out, and only E_{RT} remains.

Formula;

On The Calculator;

$$EA = \sqrt{E_{RT}^{\,2} + (EL - EC)^{\,2}}$$

$$EC - EL = X^{\,2} + E_{RT}\ X^{\,2} = \sqrt{X}$$

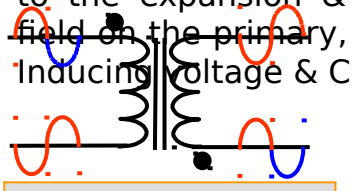
TRANSFORMER;

Mutual Inductance;

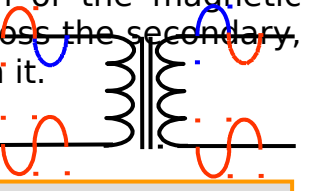
A transformer changes the AC input Voltage and Current from one value on the input to a different value on the output.

Phase;

Mutual Inductance; The process of transferring the energy from the primary to the secondary due to the expansion & contraction of the magnetic field on the primary, cutting across the secondary, Inducing voltage & Current upon it.



180º Out of Phase



IN Phase

Step Up & **Step Down;**

Power;

Step Up & Step Down Refers only to Voltage, Current is the opposite.

Power in, is equal to, Power out. Transformers will be considered 100% efficient.

$$E_P\ X\ I_P = E_S\ X\ I_S$$

Voltage (E) is stepped up, Current (I) is stepped down.
Power is a product of Voltage & Current, E X I = P

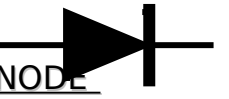
Power Supply; Changes the AC Line Voltage to the required DC operating Voltages for the designated equipment. It can be + or **-** or both.

Rectifier; Changes the AC output of the Transformer to PULSATING DC.
+ or **-** Half wave
+ or **-** Full wave

Diode; Sometimes referred to as a Crystal. Allows Current to flow in 1 direction, It acts like a one way valve, or one way Current device.
Advantages; Small in size, Low Voltage ops, Uses less power.
Disadvantages; Sensitive to Heat & High Voltage.

Letter Symbol; **CR** or **D , CR1, 2, 3, …**

Schematic Symbol;



Positive Material, ANODE CATHODE, Negative Material

Bias; Is the Difference of Potential between 2 points or Elements.

Forward Bias; When the Polarity of the Signal agrees w/ the Polarity of the material.
Current flow is Maximum, Resistance is Minimum.

Reverse Bias; When the Polarity of the Signal “Disagrees” w/ the Polarity of the material.
Current flow is Minimum, Resistance is Maximum.

Note: Current Flows against the Arrowhead, to the most positive point in the Ckt.

½ Wave Rectifier; The position of the Diode in respect to the input will determine the polarity of the output. 1 diode makes it a ½ Rectifier. Frequency in = Frequency out.

Full Wave Rectifier; The Full Wave is identified by two diodes. Position of the diode in ref to direction of the input signal describes the output polarity. Only one diode conducts @ a time. Output freq is twice the input.

Filter; The Filter converts pulse-sating DC from the rectifier, to Ripple DC & raises the DC voltage level.

AC: COMMON ACRONYMS.

@	At
A/O	As Of
&	And
Ckt	Circuit
PWR	Power
W/	With
W/O	With out